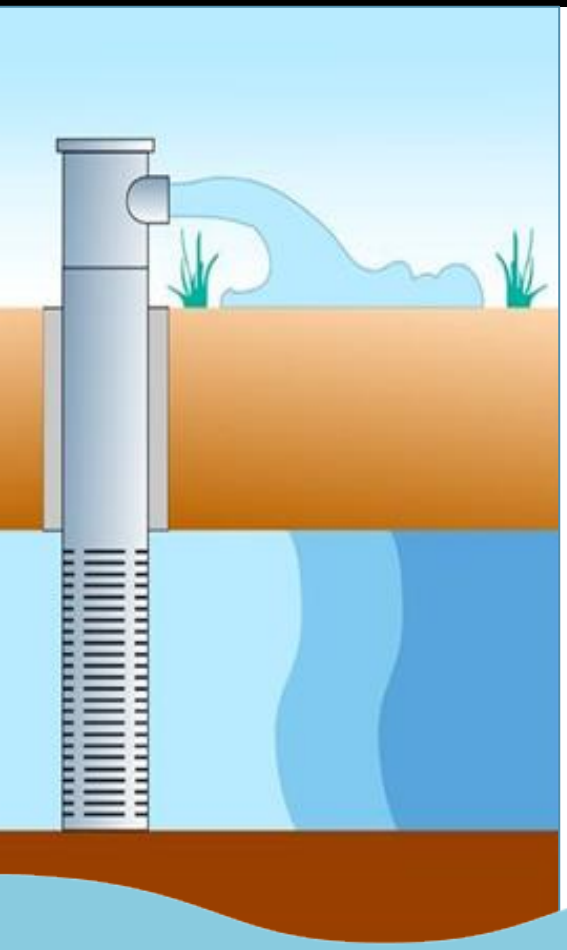


Update on Aquifer Storage and Recovery

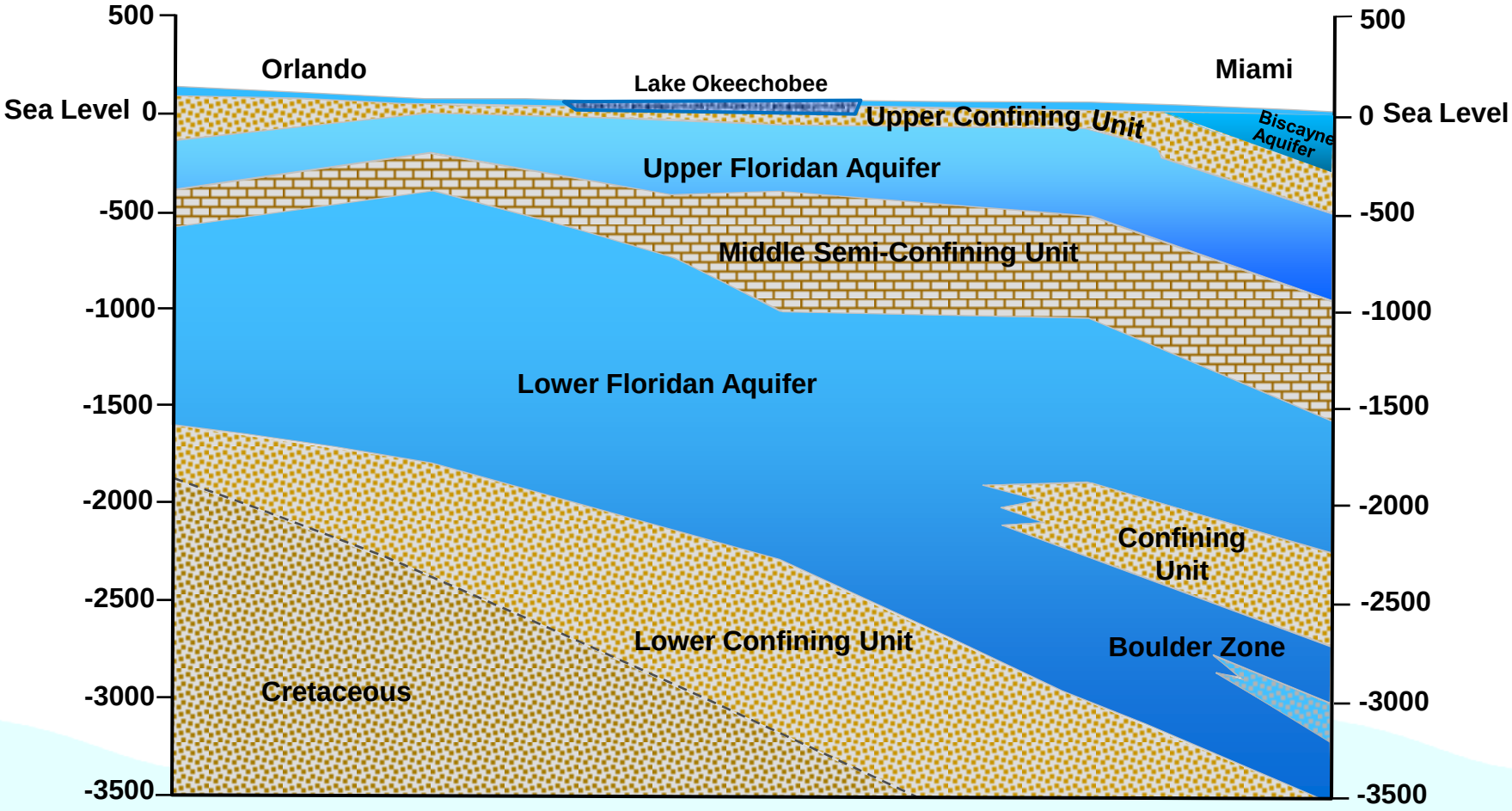
Dean Powell
Bureau Chief
Water Supply Bureau

Governing Board Workshop
September 2013

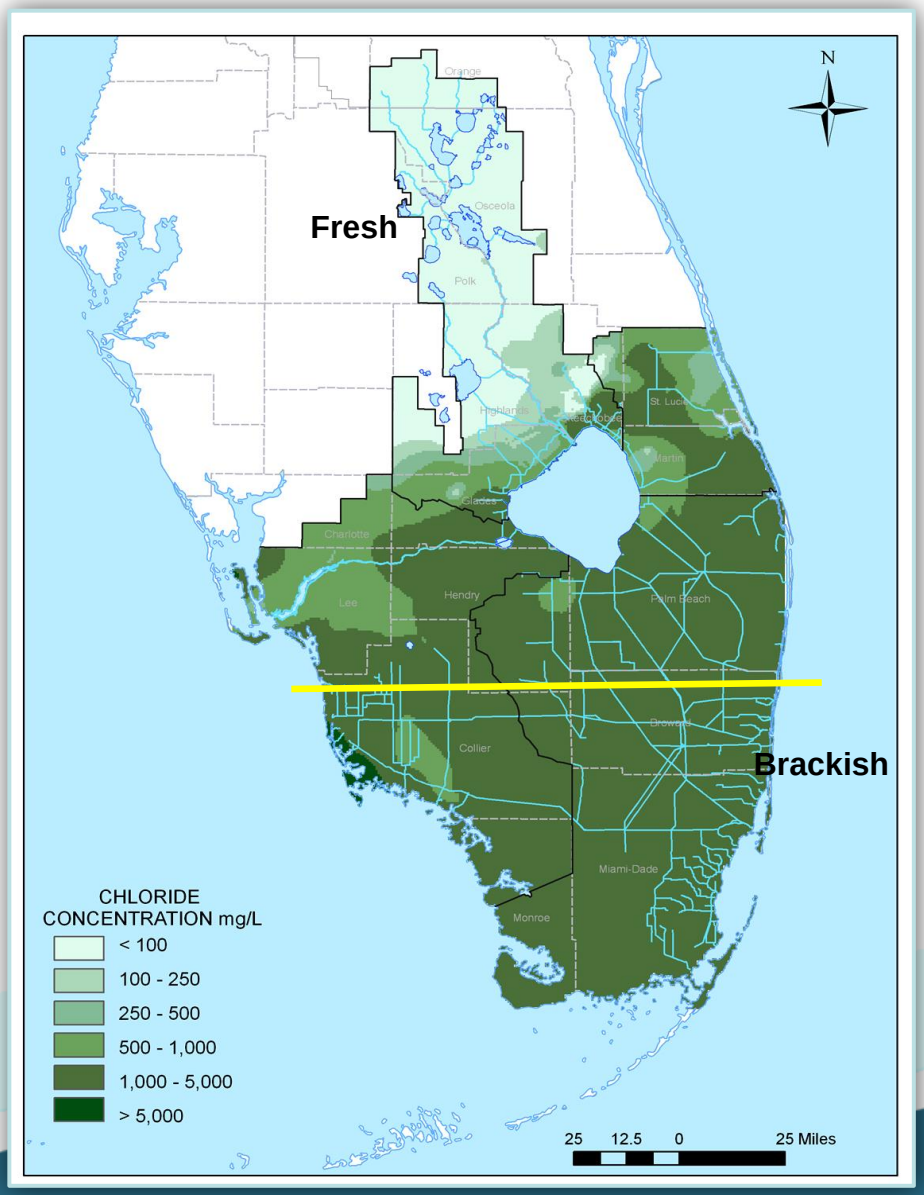
Objectives

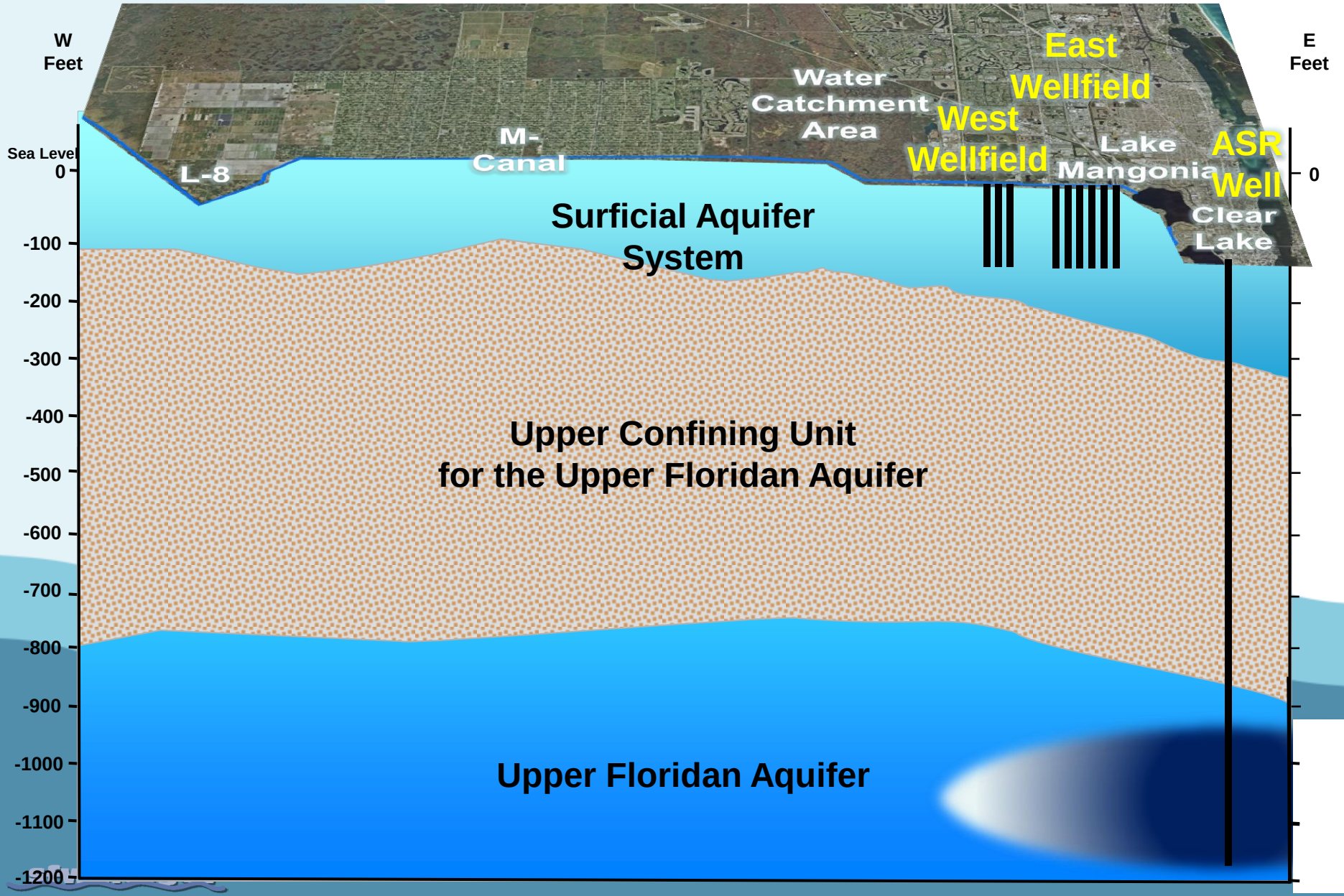
- Discuss the basics of aquifer storage and recovery (ASR) technology
- ASR benefits and challenges
- CERP ASR Program
- Profiles of utility ASR systems in south Florida
- ASR potential in Central Florida Water Initiative Area

Generalized Cross Section from Central to South Florida



Salinity of the Upper Floridan Aquifer




W
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Feet
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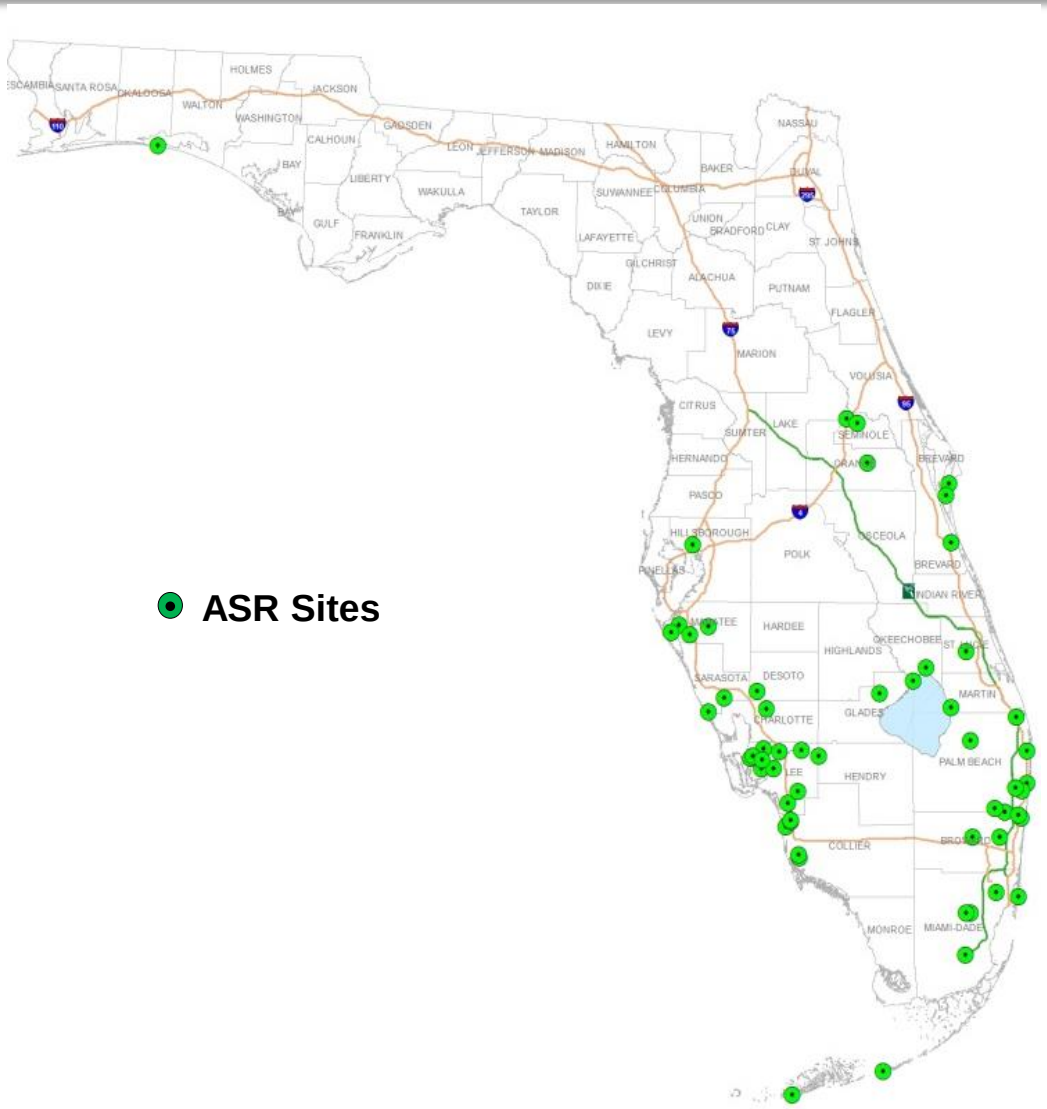
M-
Canal
Water
Catchment
Area
East
Wellfield
West
Wellfield
Lake
Mangonia
ASR
Well
Clear
Lake
Surficial Aquifer
System
Upper Confining Unit
for the Upper Floridan Aquifer
Upper Floridan Aquifer

Florida Operating ASR Wellfields



- **40 ASR wellfields under permits in Florida**
- **Most systems installed at utility-owned water treatment plants**
- **Water sources include potable, treated surface water, groundwater and reclaimed water**

ASR Benefits

- Ability to store large (multi-year) volumes of water
- Requires limited land acquisition, small footprint
- Eliminates losses due to evaporation
- Optimizes the function of reservoirs and surface features

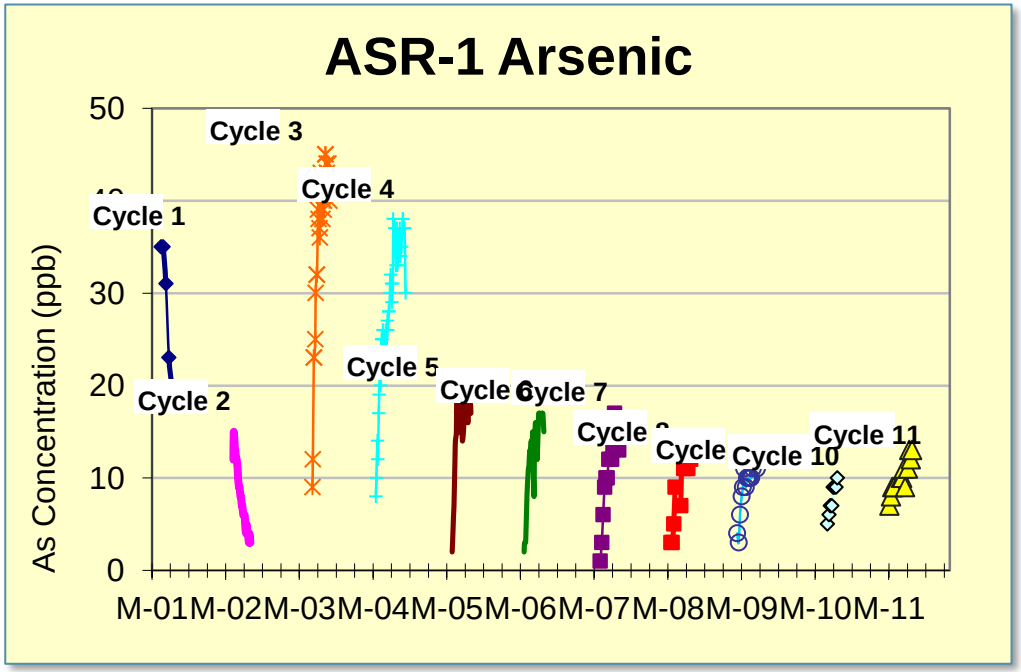
ASR Challenges

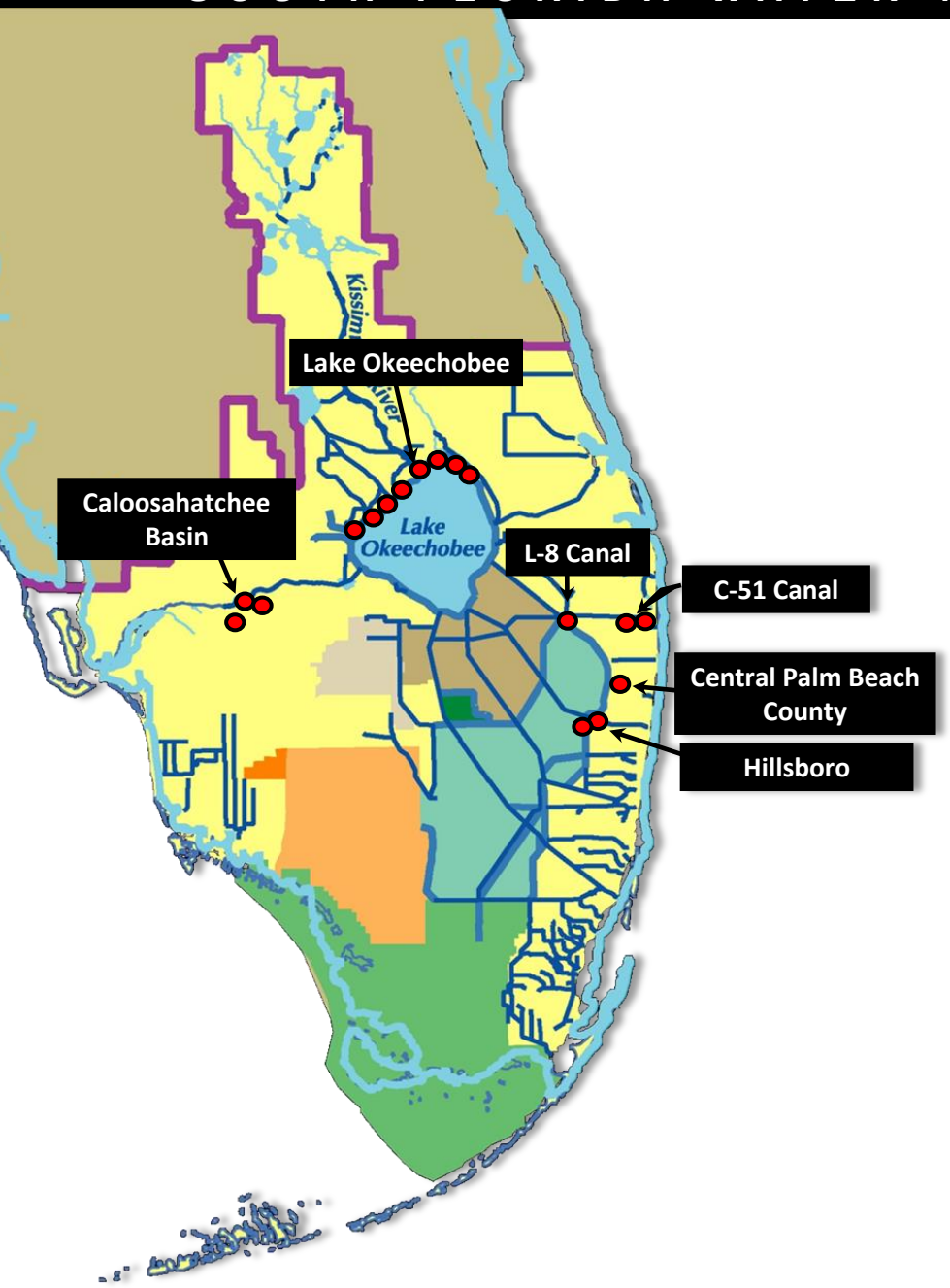
- Dependent upon local hydrogeology and water quality
- Is an “engineered” solution to water storage
- Chemical reactions in aquifer could produce undesirable water quality (arsenic)
- Individual well capacities (1-5 mgd) are low relative to surface pumping systems
- Wells can be susceptible to clogging
- Regulations require intensive treatment
- Initial monitoring is expensive

Arsenic

- Regulatory limit for potable water is 10 ppb
- Dissolved oxygen liberates it from pyrite minerals in the aquifer
- Declines over time with repeated cycles
- Technology exists to pre-treat water prior to injection as demonstrated at Bradenton

- FDEP has issued Administrative Orders to allow for decline over time
- FDEP recently issued a permit for the Peace River ASR system using a Water Quality Criteria Exemption - fully treated finished water meets all water quality criteria



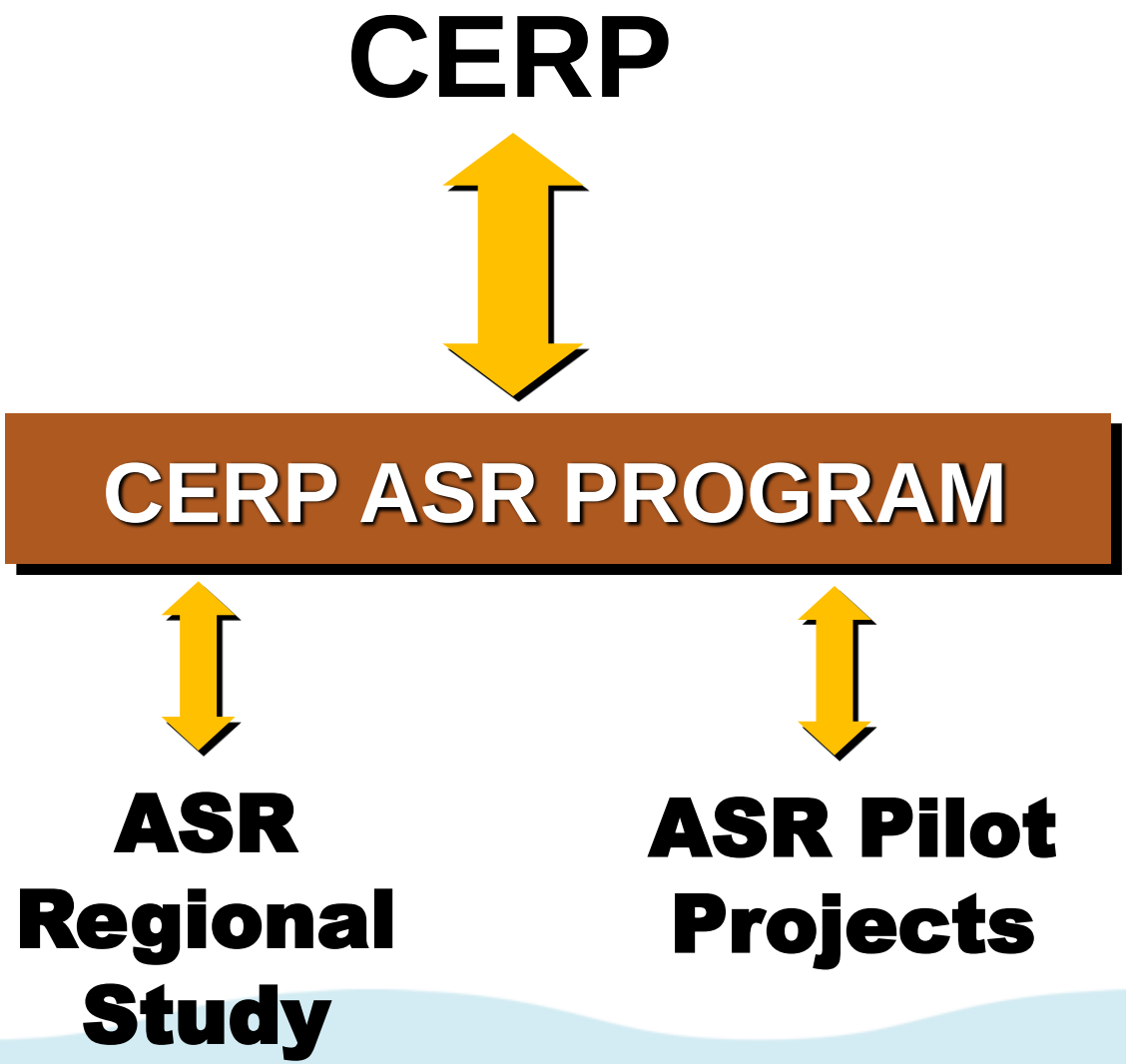


CERP ASR

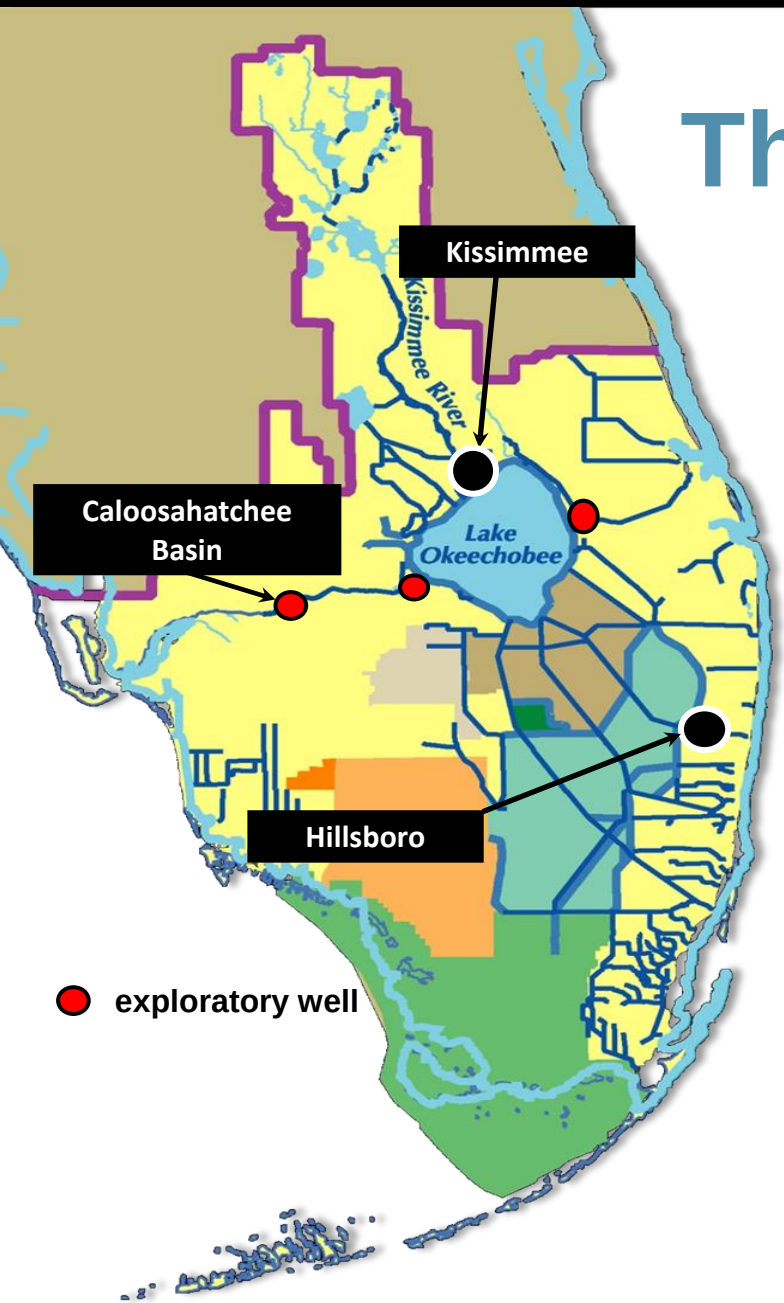
Site	Wells
Lake Okeechobee	200
Caloosahatchee	44
L-8 Basin	10
C-51 Basin	34
Central PBC	25
Hillsboro	30
TOTAL	**333**

Assumption that each well will yield 5 mgd.

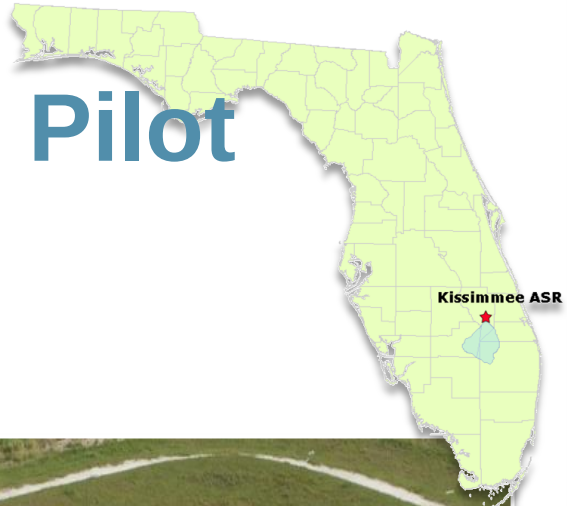
Implementation Strategy



The ASR Pilot Projects

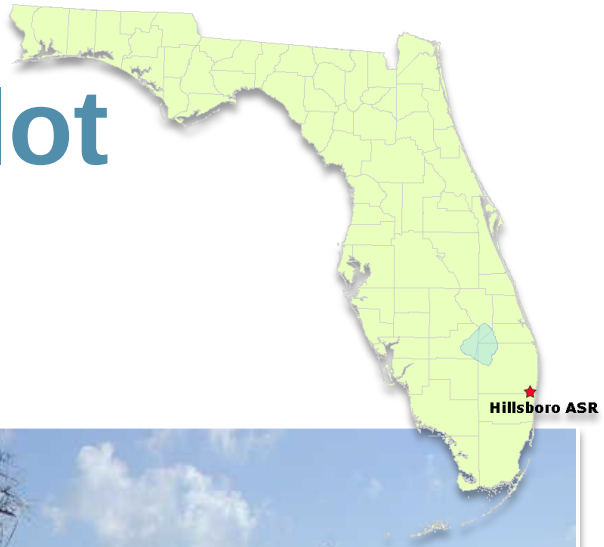


CERP Kissimmee River ASR Pilot



- Media-filtered surface water, followed by UV disinfection
- Recovery efficiency near 100%
- Some early arsenic but later diminished
- Ultraviolet disinfection impacted by water quality
- Well rehabilitation required
- Apparent nutrient reduction
- Built by USACE, now transfering of ownership to SFWMD

CERP Hillsboro ASR Pilot

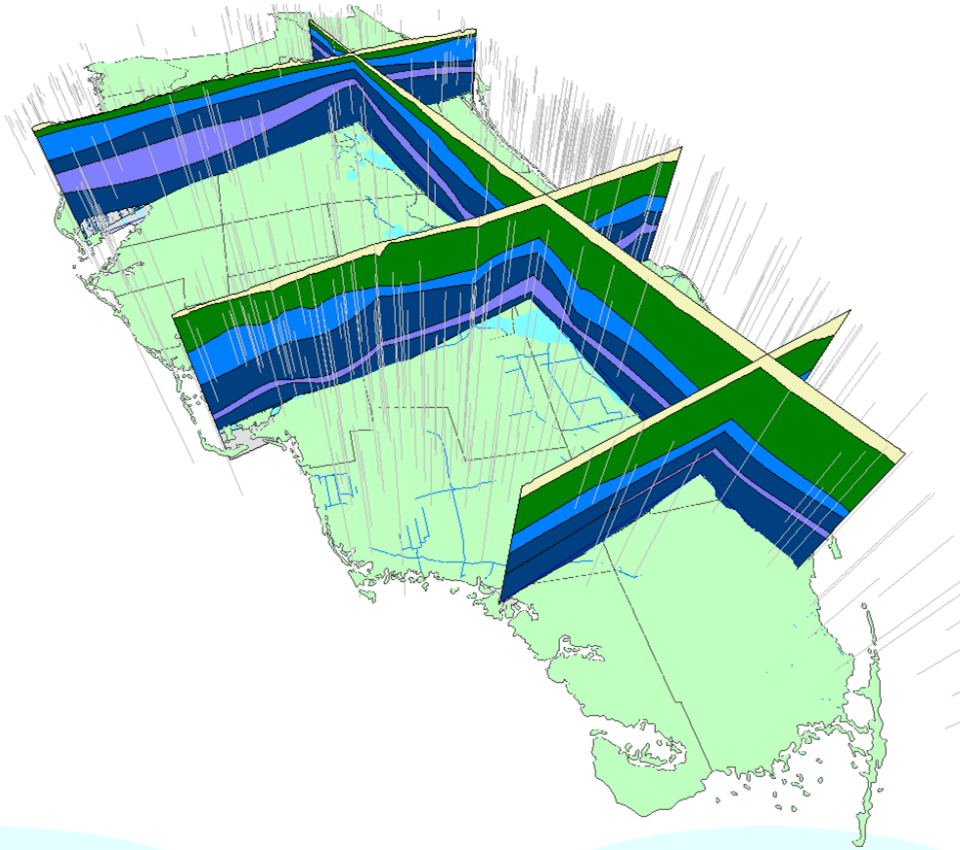


- Mechanical filtration coupled with UV disinfection
- Three test cycles through 2012
- Lower recovery efficiency (40%) because aquifer more saline
  - *Expected to increase with continued cycles*
- Well rehabilitation required
- Built by SFWMD, currently looking to partner with a local utility to keep operating

What have we learned from the pilots?

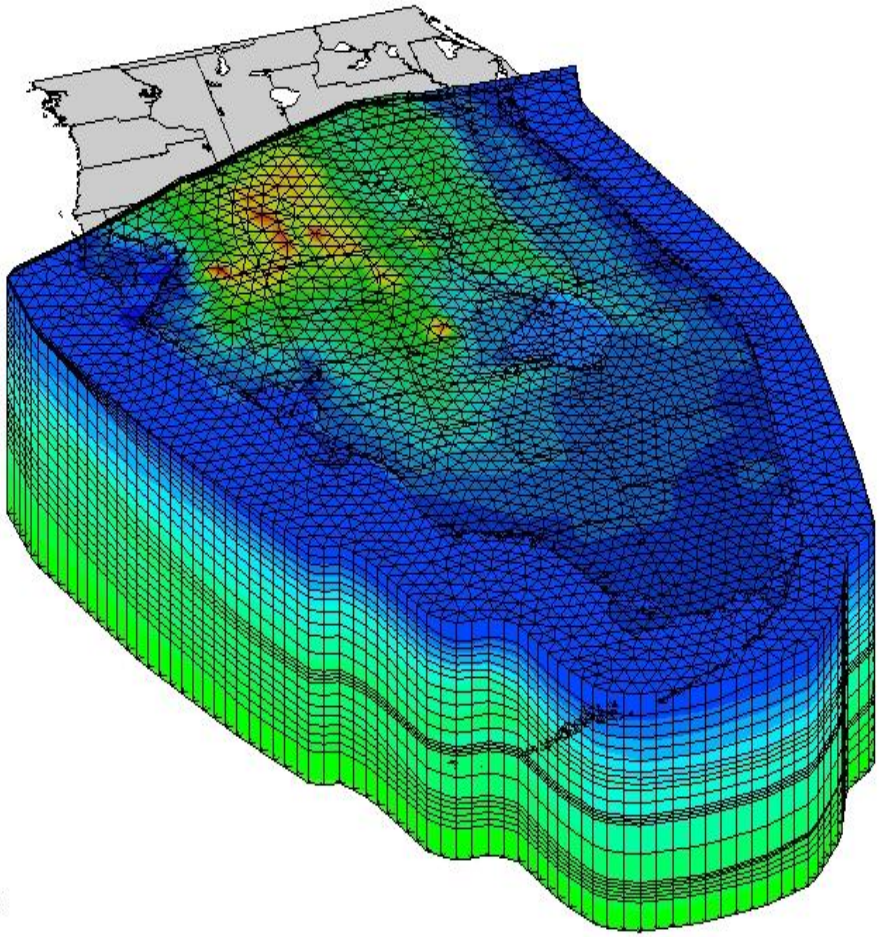
- High-capacity (5-mgd) ASR wells are possible
- Site specific – Berry Groves area unsuitable - exploratory wells are necessary
- Wells completed in fresh portions of the aquifer will have high recovery efficiencies
- Arsenic less of a problem with lightly-treated surface water compared to highly treated, finished drinking water
- Basic filtration coupled with disinfection can work
  - *Although the UV systems at the pilots were challenged*
- ASR wells may be prone to plugging
  - *Can be managed by rehabilitation and maintenance*

CERP ASR Regional Study



- To address regional issues beyond the scope of the pilot projects
- Multiple hydrogeologic, geophysical, and geotechnical studies
- Groundwater model completed
- Ecological risk assessment underway
- Final report due in 2014

ASR Regional Study Groundwater Model Results



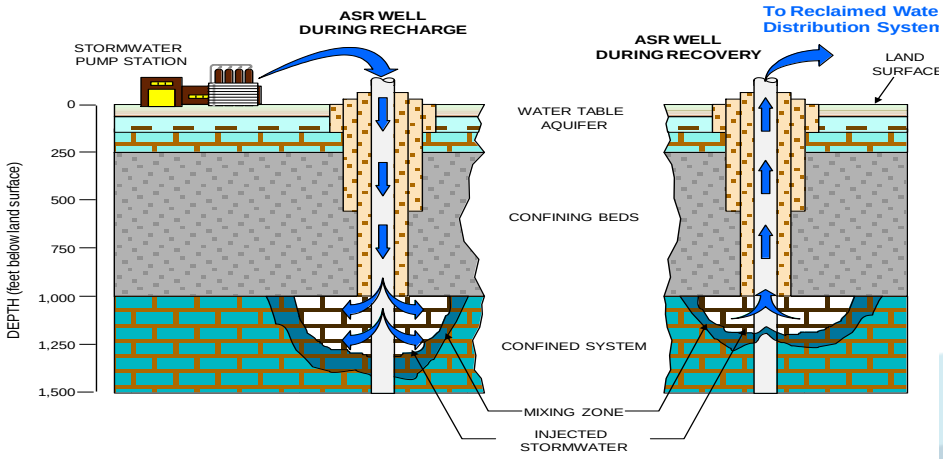
- Simulations assumed wells distributed in locations as envisioned in CERP
- Took into account potential for:
  - Rock fracturing
  - Injection pressure (less than 100 psi)
  - Salt water intrusion
  - Impacts to nearby artesian users
  - District regulations
- **Modeling indicates that only 140 ASR wells can be operated to meet all criteria**

Utility ASR

- Most systems installed by PWS utilities
- Usually around 1 MGD
- Manatee County (1983)
- Peace River (1985)
- Cocoa (1987)
- Boynton Beach (1993)
- Marco Island (1997)
- Several dozen more through 2013

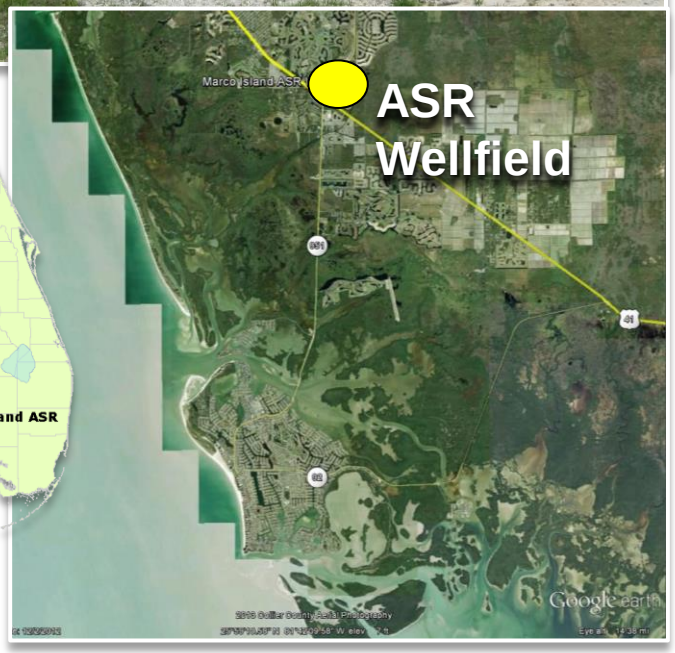
Naples Reclaimed Water ASR

- Excess surface water (up to 10 mgd) from Golden Gate Canal
- Reduces harmful discharges of surface water to Naples Bay
- Store surface and reclaimed water in 2, 2 mgd ASR wells
- Eliminates effluent discharge to Gordon River
- Maximizes use of reclaimed water
- District (BCB) contributed $1.1 Million



Marco Island ASR System

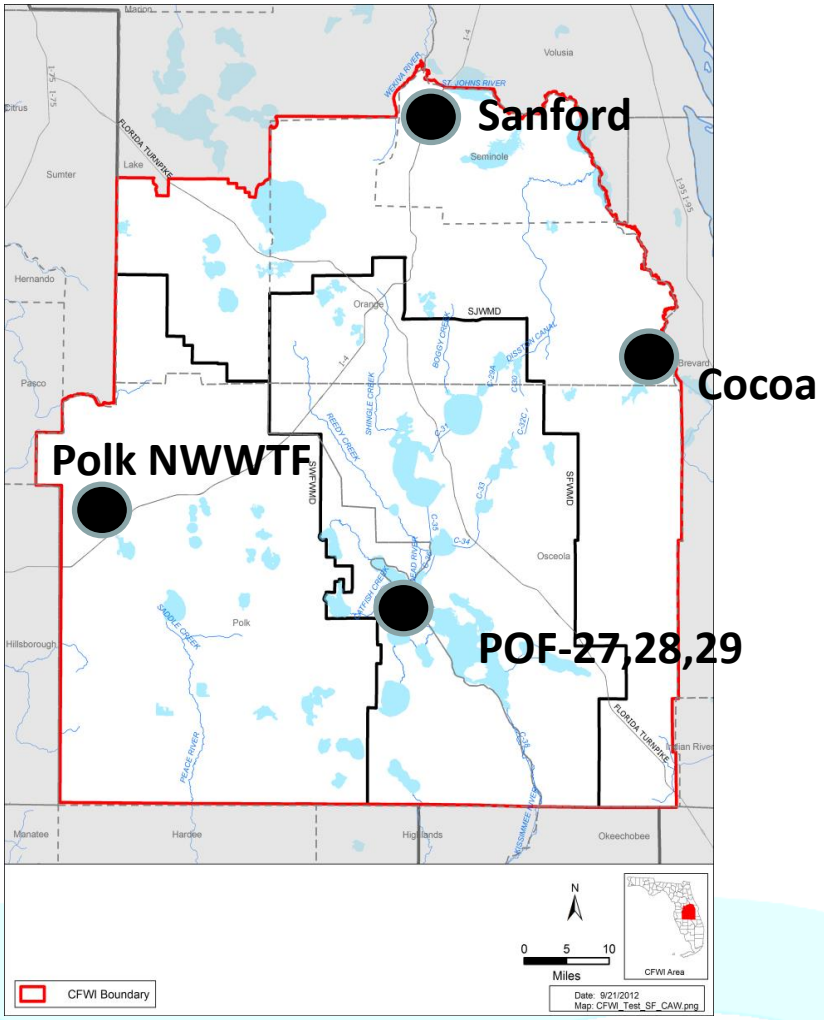
- The largest in SFWMD
- 7 wells, 17.5 mgd capacity
- Surface water from Marco Lake supplemented by Henderson Creek
- Filtered & chlorinated
- Arsenic not an issue
- District (BCB) contributed $1.4 Million



Peace River System

- The largest system in Florida
- Fully treated surface water
- 21 wells - 20 mgd capacity
- ASR integrated with reservoir
- Arsenic has been an issue

ASR Potential in the CFWI



- City of Cocoa
  - Potable water ASR, since 1991
  - Originally 6 wells, now 10
  - 1 MGD per well, 350’ deep
- City of Sanford
  - Potable water ASR, cycle testing
- Polk County Northwest WWTF
  - Reclaimed water ASR
  - Exploration underway above and below the USDW
- SFWMD test well POF-27,28,29
  - Multiple zones available
  - Highly variable water quality

In conclusion….

- ASR has a long history in Florida
  - *Expanding slowly*
- Arsenic has been an issue, but can be dealt with:
  - *An administrative process (Water Quality Criteria Exemption)*
  - *Removing oxygen prevents arsenic from releasing*
- The pilot projects were successful
  - *Although the total number of CERP ASR wells is fewer than envisioned*
- ASR zones are available in the CFWI
  - *Site selection followed by test wells is required*

Questions?

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